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(54) V-belt-type automatic transmission for vehicle

(57) To achieve this, a V-belt-type automatic transmission for a vehicle is provided with a drive pulley 38 and a driven pulley 48, wherein a plurality of centrifugal weights 42 and 43 arranged between a movable pulley piece 40 of a drive pulley 38 and a cam plate 41 are moved in a radial direction by the centrifugal force, the wrapping radius of the V-belt 67 wound around the drive pulley 38 and the driven pulley 48 is changed, a maximum gear ratio in a low-speed rotation range and a minimum gear ratio in a high-speed rotation range are set, the movement in a radial direction of the centrifugal weight 43, one of the plurality of centrifugal weights 42 and 43, is actually prevented by the stopper surface 40h at the rotational speed in a middle-speed rotation range, and the middle gear ratio is set. The centrifugal weight 43 is made lighter than the remaining centrifugal weight 42, and the stopper surface 40h is sloped, and therefore a pressing force pressing the centrifugal weight 43 against cam plate 41 will be generated.

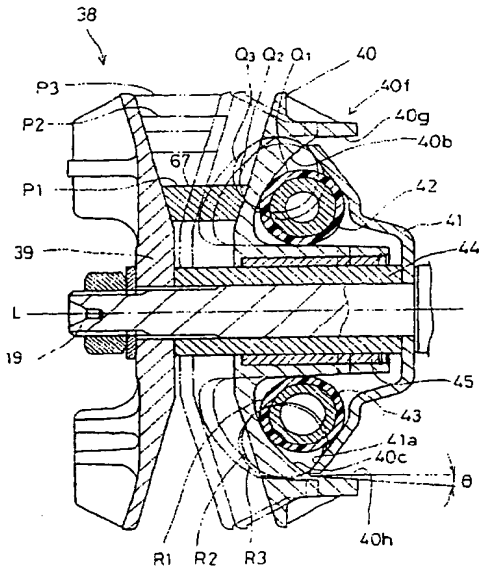

FIG. 5

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Description

[0001] The present invention relates to a V-belt-type automatic transmission for a vehicle comprising centrifugal weights, mounted on a vehicle such as a motorcycle.

[0002] In the related art, for example, a V-belt-type automatic transmission mounted on a motorcycle comprises a V-belt wound around and extending between a drive pulley provided at the end of a crankshaft of an internal combustion engine and a driven pulley provided on a driven shaft linked to a rear axle 12 by a final reduction gear.

[0003] When rotational speed of the internal combustion engine increases, with respect to the drive pulley, a movable pulley pressed by a weight roller moving out radially under centrifugal force approaches a fixed pulley piece, while with respect to the driven pulley, a movable pulley piece urged by a spring moves away from the fixed pulley piece against the spring force. Thus the wrapping radius of the V-belt of drive pulley and driven pulley is automatically changed, and the gear ratio decreases.

[0004] A V-belt-type automatic transmission is shown, for example, in Japanese Patent Laid-open Publication No. Sho. 59-113353, where in a middle speed range, between a low-speed rotation range where the gear ratio is set at maximum and a high-speed rotation range where the gear ratio is set at minimum, a middle gear ratio is obtained having a value between in the two gear ratios.

[0005] In the fourth embodiment of the transmission apparatus disclosed in this Japanese Patent Laid-open Publication, a pair of sloped surfaces on which a weight rolls are provided on a rear surface of a right pulley element of a drive pulley. The stopper surface of one of the pair of sloped surface is arranged radially more inward than the stopper surface of other sloped surface, and the weight comes into contact with the stopper surface of the other sloped surface, in the middle-speed rotation range. Thus radial movement is prevented and the middle gear ratio is set.

[0006] Generally, in a driven pulley of a V-belt-type automatic transmission, a movable pulley piece is urged towards a fixed pulley piece by the spring force of a cylindrical shaped pressed coil spring, and the movable pulley piece moves in an axial direction against or urged by the spring force in the event of change in the wrapping radius of the V-belt A spring guide is also provided inside the spring, and the spring guide prevents the spring from collapsing or bending.

[0007] The right pulley element of the transmission disclosed in the Japanese Patent Laid-open Publication moves further in the axial direction by the weight rolling on the other sloped surface in the high-speed rotation range, and so a gap in the axial direction is arranged between the weight, coming into contact with the stopper surface of the other sloped surface and prevented from moving in the radial direction, and the right pulley element. As a result, due to engine vibrations, etc., there is relative movement in the axial direction between the right pulley element and the weight, and a cover, sandwiching the right pulley element and the weight, and the weight collide causing abrasion, and the weight is prevented from moving smoothly in the radial direction, therefore possibly causing difficulty in smooth transmission.

[0008] With respect to the driven pulley, as a result of friction with a spring guide partly coming into contact with the internal circumference of the spring to enable its function when the spring is expanded or contacted, or as a result lack of smooth spring contraction due to contact of the spring against a tip of the spring guide during spring contraction, the movable pulley piece may be prevented from moving smoothly, and transmission may not be operated smoothly.

[0009] The present invention has been conceived in view of the above described situation, and an common object of the present invention disclosed in claim 1 through 4 is to provide a V-belt-type automatic transmission for vehicles that is capable of smooth transmission.

[0010] The invention disclosed in Claim 1 of this application is A V-belt-type automatic transmission for a vehicle, having a wrapping radius of a V-belt, which is wound around a drive pulley provided on a drive shaft of an engine and a driven pulley provided on the driven shaft to transmit torque of the drive shaft to the driven shaft, changed based on movement in a radial direction along both guide surfaces of a plurality of centrifugal weights arranged between a pulley side guide surface provided on a movable pulley piece of a drive pulley and a cam side guide surface provided on a cam plate, a maximum gear ratio in a low-speed rotation range and a minimum gear ratio in a high-speed rotation range are set, and some of the plurality of centrifugal weights are actually prevented from moving in a radial direction at a speed faster than a prescribed rotational speed in a middle-speed rotation range, to thereby set a middle gear ratio in a middle-speed rotation range, wherein some of the centrifugal weights are lighter than the remaining centrifugal weights.

[0011] In the invention disclosed in Claim 1, in a high-speed engine rotation range, some of the centrifugal weight actually prevented from moving in a radial direction never move in a radial direction along the both guide surfaces, and so a space is arranged between some of the centrifugal weights and a pulley side guide surface or cam side guide surface. In this state, vibrations of the engine, etc. are transmitted to the drive pulley and cause the drive side movable pulley piece, cam plate and some of the centrifugal weights to move relative to each other, and some of the centrifugal weights sometimes collide with the pulley side guide surface and cam side guide surface. However, the weight of some of the centrifugal weights are lighter than the remaining centrifugal weights so that the energy caused by the collision de-

creases and the wear of each pulley side guide surface, cam side guide surface and centrifugal weight decreases. As the energy caused by the collision is small, noise due to collisions is smaller, and noise is reduced.

[0012] As a result, wear of each pulley side guide surface, cam side guide surface and centrifugal weight is reduced, and so the centrifugal weight can move smoothly in the radial direction, and smooth transmission is made possible. Also, wear of those parts is reduced, and transmission characteristics that have been set over the long term can be kept. Moreover, the noise due to collision of centrifugal weights is reduced.

[0013] The invention disclosed in claim 2 is a V-belt-type automatic transmission for a vehicle, having a wrapping radius of a V-belt, which is wound around a drive pulley provided on a drive shaft of an engine and a driven pulley provided on the driven shaft to transmit torque of the drive shaft to the driven shaft, changed based on movement in a radial direction along both guide surfaces of a plurality of centrifugal weights arranged between a pulley side guide surface provided on a movable pulley piece of a drive pulley and a cam side guide surface provided on a cam plate, a maximum gear ratio in a low-speed rotation range and a minimum gear ratio in a high-speed rotation range are set, and some of the plurality of centrifugal weights are actually prevented from moving in a radial direction at a speed faster than a prescribed rotational speed in a middle-speed rotation range, to thereby set a middle gear ratio in a middle-speed rotation range, wherein a stopper surface provided on the movable pulley piece, which actually prevents some of the centrifugal weights from moving in a radial direction, or a stopper surface provided on the cam plate, are sloped so that a pressing force for pushing some of the plurality of centrifugal weight against the cam plate is generated based on contact of some of the plurality of centrifugal weights against the stopper surface.

[0014] In the present invention disclosed in Claim 2, in the high-speed rotation range of the engine, some of the centrifugal weights are prevented from moving in the radial direction, and never move in the radial direction along the two guide surfaces. Therefore a space is formed between the part of the centrifugal weight and a pulley side guide surface or a cam side guide surface. In the state above, when engine vibration etc. is transmitted to the drive pulley, and a force causing relative movement between the drive side movable pulley piece and the cam plate and some of the centrifugal weights acts, some of the centrifugal weights are pressed against the cam plate by a pressing force generated by contacting the sloped stop surface, and collisions with the pulley side and cam side guide surface are reduced. Therefore wear of pulley side guide surface, cam side guide surface and centrifugal weight s are suppressed, and the noises caused by the collisions are also suppressed.

[0015] As a result, the occurrence of collisions of the centrifugal weights is suppressed and the wear of the pulley side guide surface, cam side guide surface and centrifugal weight caused by collision is reduced, so that the centrifugal weight can move in the radial direction smoothly and transmission can be performed smoothly. Also, as wear of those components is reduced, transmission characteristics can be maintained over the long term. Furthermore, noise caused by the collision of the centrifugal weights can be reduced.

[0016] The invention disclosed in Claim 3 is a V-belt-type automatic transmission for a vehicle, provided with a drive pulley attached to a drive shaft of the engine, a driven pulley attached to a driven shaft, and a V-belt wound around the drive pulley and the driven pulley to transmit the rotational power of the drive pulley to the driven pulley, the wrapping radius of the V-belt around the drive pulley and the driven pulley being changed by moving a movable pulley piece of the drive pulley against force of a spring in response to the movable pulley piece of the drive pulley being moved by centrifugal force of the centrifugal weights, wherein the spring is a cylindrical coil spring, and an outer peripheral surface of a tip of the cylindrical spring guide arranged inside the spring has a tapered shape, with the outer diameter becoming smaller towards the end.

[0017] According to the present invention as disclosed in claim 3, a space which becomes wider at its end is formed between an periphery of the spring and an outer periphery of the end of the spring guide. Therefore when speed is changed and a movable pulley piece of driven pulley moves as a movable pulley piece of the drive pulley is moved by centrifugal force and the spring is compressed, a wire rod wounded in a spiral will not be dragged in by contacting with the end of the spring guide

[0018] As a result, the movable pulley piece of the driven pulley can move smoothly and enables smooth transmission. As only the end of the spring guide has a tapered shape, the spring can be prevented from collapsing or bending at any other part of the spring guide other than its end, and therefore the function of the spring guide will not be lost.

[0019] The invention disclosed in Claim 4 is the V-belt-type automatic transmission for a vehicle disclosed in Claim 3 with a spring guide formed with synthetic resin with self lubrication characteristics.

[0020] According to the invention disclosed in Claim 4, when the spring makes sliding contact with the spring guide, the frictional force on the spring is kept small by the lubrication characteristics of the spring guide itself. As a result, the spring can be extended and compressed smoothly, and so transmission can be performed smoothly.

[0021] Embodiments of the present invention will be now described with reference to Fig. 1 to Fig. 10.

Fig. 1 A left side elevation of the rear part of the motorcycle mounted with a V-belt-type auto-

matic transmission of the present invention.

Fig. 2 A schematic cross sectional drawing taken along line II-II in Fig. 1.

Fig. 3 A diagram along arrows III in Fig. 2. with the cover of the transmission case removed.

Fig. 4 A diagram of a rear side of the drive side movable pulley piece.

Fig. 5 A cross sectional drawing taken along line V-V in Fig. 4.

Fig. 6 A cross sectional drawing taken along line VI-VI in Fig. 4.

Fig. 7 An enlarged view of essential portions of Fig. 5, with the drawing describing the pressing force against the cam plate.

Fig. 8 An enlarged cross section of the driven pulley.

Fig. 9 An enlarged drawing of the spring guide.

Fig. 10 A drawing describing the operational characteristics of V-belt-type automatic transmission.

[0022] Fig. 1 shows a rear part of scooter-type motorcycle 1 fitted with a V-belt-type automatic transmission for a vehicle of the present invention. A power unit 3 arranged below a vehicle frame 2 comprises an internal combustion 4 as an engine, and a transmission 6 (refer to Fig. 3) transmits the power from the internal combustion engine 4 to rear wheel 5. The transmission 6 is stored in a transmission case 7. A hangar bracket (not shown in the drawing) provided in a protruding condition above the crankcase 11 (refer to Fig. 2) of a hangar bracket 9 and the internal combustion 4 provided in a protruding condition above and in front of transmission case 7 of power unit 3 are both mounted so as to be able to swing about a pivot shaft 8 held by a pair of left and right brackets provided above a sloping part extending above and diagonally to the rear part of vehicle frame 2. As the rear part of the power unit 3 is supported by the vehicle frame 2 via a shock absorber 10, the power unit 3 is can move back and forth in a vertical direction toward the vehicle frame 2 with the pivot shaft 8 set as its center.

[0023] As shown in Fig. 2 and Fig. 3, the transmission case 7 is made up of a left crankcase 11L of the crankcase 11 divided left and right and formed integrally with the case body 7a, and a cover 7b attached to case body 7a on the left side. It is also arranged on the left side of a motorcycle 1 while extending from the crankcase 11 of the internal combustion 4 in the vicinity of the rear axle 12. On the cover 7b, a cover 13 with a shroud is mounted, and a V-belt 67 is cooled by the air sucked in from the shroud and blown by the fan arranged on the rear surface of a drive side fixed pulley piece which is a constitutional element of a drive pulley of automatic transmission 35 which will be described later.

[0024] The internal combustion engine 4 is a single cylinder 4-cycle SOHC (single over-head camshaft) type water cooled internal combustion engine. A cylinder 14 arranged with its axial line oriented slightly diagonally above and in front of motorcycle 1, and a cylinder 15 are laid on top of one another and connected by bolts. A crankshaft 19 rotatably supported by left side and right side crankcases 11L, 11R via respective ball bearings 17, 18 is connected to a piston 20 fitted into the cylinder 14 so as to slide in a reciprocating manner via a connecting rod 21. The crankshaft 19 is rotated and driven by reciprocation of the piston 20.

[0025] An intake port connected to a carburetor 22 via an intake pipe, and an exhaust port connected to an exhaust pipe, are arranged on the cylinder head 15. In a valve chamber made up of a cylinder head 15 and a cylinder head cover 16 connected to the cylinder head 15 with bolts, a cam shaft 23 made up of an intake cam and an exhaust cam, each driving so as to open the intake valve and exhaust valve via rocker arms, is supported rotatably in the cylinder head 15. An air suction pipe 24, which supplies air taken in from air cleaner via a reed valve device as exhaust secondary air is connected to the exhaust port. An air amount control valve 25 which controls the amount of exhaust secondary air is provided in the air suction pipe 24, and reference numeral 26 is a spark plug mounted projecting into the fuel chamber 27.

[0026] A cam drive sprocket 28 and a sprocket 29 for an oil pump and a water pump are spline connected to a part of the crankshaft 19, projecting to the right side from a ball bearing 18, close to the ball bearing 18. The cam drive sprocket 28 is connected to and drives the cam driven sprocket 30 spline connected to the cam shaft 23 via a timing chain 31 wound between the two sprockets 28 and 30. The cam shaft 23 is rotated at 1/2 the rotational speed of the crankshaft 19. A pump drive sprocket 29 is connected to and drives a pump driven sprocket spline connected to the pump shaft via a chain. A starter driven gear 33 connected to and driven by a starter motor 32, and an alternator 34, are provided at the right side of the right end part of the crankshaft 19.

[0027] The transmission 6 is provided with a V-belt-type automatic transmission 36, centrifugal-type starting clutch and final reduction gear 37. The drive pulley 38 of the V-belt-type automatic transmission 35 is arranged at the left end of the crankshaft 19 extending to the left side of a ball bearing 17. A drive pulley 38 is provided with a drive side fixed pulley piece 39 spline connected close to the left end of crankshaft 19, as a drive shaft, a drive side movable pulley piece 40 positioned to the right side of the drive side fixed pulley piece 39, a cam plate 41 fitted to crankshaft 19 and positioned to the right side of the movable pulley piece 40, and weight rollers 42 and 43 as a plurality of centrifugal weights arranged between the drive side movable pulley piece 40 and the cam plate 41.

[0028] The cam plate 41 is fixed in the axial direction of the crankshaft 19 with a sleeve 44 joined at the drive side fixed pulley piece 39 and outer periphery of crankshaft 19, so that the cam plate 41, drive side fixed pulley

piece 39 and sleeve 44 rotate integrally with the crankshaft 19. The drive side movable pulley piece 40 is fitted into the outer periphery of a slide collar 45 slidably fitted into in an outer periphery of the crankshaft 19 in an axial direction of the crankshaft 19, and is fixed integrally with the slide collar 45 in an axial direction by a detent ring. An engagement piece 46 fixed on the cam plate 41 is fitted to a projecting piece 40a formed on a rear surface of the drive side movable pulley piece 40 opposite to a contact surface of a V-belt 67, to be described later, in such a state that it is slidable in the axial direction and fixed in the rotating direction, which means that the drive side movable pulley piece 40 can move in the axial direction of the crankshaft 19 and also rotate together with cam plate 41.

[0029] As shown in Fig. 4 through Fig. 6, on a rear surface of drive side movable pulley 40, 6 pulley side guide surfaces 40b, 40c for guiding a plurality of weight rollers 42, 43, are formed extending in a radial direction of the crankshaft 19, and consisting of curved surfaces or sloped surfaces sloping down to the cam plate 41 as it runs radially outwards relative to the plane surface which is at right angles to a rotating axis line L of the crankshaft 19 (hereafter also referred as orthogonal plane surface), and formed in a peripheral direction of the drive side movable pulley piece 40 keeping a radial clearance. Also, on both sides in a peripheral direction of each pulley side guide surface 40b, 40c, a pair of ribs 40d, 40e are formed with a clearance slightly wider than the length of a weight roller 42, 43 in an axial direction. On the surface of the cam plate 41 at a drive side movable pulley piece 40 side, a cam side guide surface 41a is formed with a circular surface sloped down to the drive side movable pulley piece 40 as it runs radially outwards relative to the orthogonal plane surface. Each weight roller 42, 43 is stored movable in a radial direction of the crankshaft 19, coming into contact with both the pulley side guide surfaces 40b, 40c, and the cam side guide surface 41a in a groove A formed by the pulley side guide surface 40b, 40c and a pair of ribs 40d, 42e placed between each pulley side guide surface 40b, 40c and the cam side guide surface 41a.

[0030] The 6 pulley side guide surfaces 40b, 40c comprise 3 pairs of guide surfaces consisting of a first pulley side guide surface 40b and a second pulley side guide surface 40c having different shapes. On the rear surface of the drive side movable pulley piece 40, cylindrical section 40f having a cylindrical shape is arranged at the outer position in a radial direction of the pulley side guide surface 40b, 40c protruding towards the cam plate 41 side. Inside the cylindrical section 40f, in correspondence with first and second pulley side guide surfaces 40b, 40c, a first stopper surface 40g to prevent a first weight roller 42 from moving outwards in a radial direction, to be described later, and a second stopper surface 40h actually preventing a second weight roller 43 from moving outwards in the radial direction, to be described later, are provided. The second stopper surface 40h is positioned further inwards in the radial direction than the first stopper surface 40g. Accordingly, the length of the second pulley side guide surface 40c in the radial direction is shorter than the first pulley side guide surface 40b in the radial direction, but at a part further inwards than the position where the second stopper is arranged, the shape of each guide surface of the first and second pulley side guide surfaces 40b, 40c are similar. First and second pulley side guide surfaces 40b, 40c are arranged alternately in the peripheral direction, and 3 first pulley side guide surfaces 40b are provided at a uniform distance, and 3 second pulley side guide surfaces 40c are also provided at a uniform distance.

[0031] 6 weight rollers 42, 43 with similar shapes comprise 2 types of weight rollers, namely 3 first weight rollers 42 and 3 second weight rollers 43 with the weight of the second weight rollers being lighter than the first weight rollers 42. The first weight rollers 42 are arranged to be guided by the first pulley side guide surface 40b, and the second weight rollers 43 are arranged to be guided by the second pulley side guide surface 40c. In Fig. 5, showing a cross section of part of it, first, second weight rollers 42, 43 are provided with cylindrical sections 42a, 43a with similar outer diameters and different inner diameters. The peripheral surfaces of the cylindrical sections 42a, 43a and ends of those close to the outer periphery are covered with a cover 42b, 43b made of synthetic resin. Therefore, the drive side movable pulley piece 40 and the cylindrical sections 42a, 43a, both made of metal, are prevented from coming into contact with each other, so that each weight roller 42, 43 can rotate smoothly.

[0032] Next, both stopper surfaces 40g, 40g will be described. The first stopper surface 40g comprises a plate surface at approximately right angles to the orthogonal plane surface, and prevents the first weight roller 42 from moving in a radial direction in the high-speed rotation range where rotational speed is higher, so that a minimum gear ratio is set. The second stopper surface 40h comprises a sloped plane surface crossing the orthogonal plane surface forming an acute angle of θ smaller than 90° at an outer side in the radial direction, so that the distance from a rotating axis line L increases further to the end of the cylindrical section 40f along the axial direction of the crankshaft 19.

[0033] Angle θ is set to prevent the second weight roller 43 from coming into contact with the second pulley side guide surface 40c in the high-speed rotation range after coming into contact with the second stopper surface 40h in a condition where the rotational speed of the internal combustion 4 reaches the designated minimum rotational speed in the middle-speed rotation range where the middle gear ratio is set, as described later. Also, angle θ is set so as not to actually participate in transmission in the high-speed rotation range where the minimum gear ratio is set, i.e., to make a force component based on the centrifugal force of the second weight roller 43 applied by coming into contact with the second

stopper surface 40h that moves the drive side movable pulley piece 40 in the axial direction as small as possible, so that first weight roller 42 does not govern the movement of drive side movable pulley piece 40 in the axial direction as a result of movement of the first weight roller 42 in the radial direction on the first pulley side guide surface 40b.

[0034] As the second stopper surface 40h slopes, as described in Fig. 7, when the second weight roller 43 comes into contact with the second stopper surface 40h, the center of gravity of the second weight roller 43 C1 is positioned closer to the cam plate 41 by a designated distance d in the axial direction of the crankshaft 19 from the contact line C2 of the second weight roller 43 and second stopper surface 40h. In Fig. 7, as centrifugal force F effects the second weight roller 43 and a moment M acts in a clockwise direction, the second weight roller 43 rolls and moves slightly in a radial direction and comes into contact with the cam plate 41, and after that the second weight roller 43 is also pressed against the cam plate 41 by the moment M. The second weight roller 43 is also pressed against the cam plate 41 as a result of the force component Ft towards the cam plate 41 of the centrifugal force F, caused by the second weight roller 43 coming into contact with second stopper surface 40h. As a result, in a high speed rotation range, even when vibrations of the internal combustion engine 4 cause vibration of drive pulley 38 in the axial direction of the crankshaft 19, a space in the axial direction between the second pulley side guide surface 40c and the second weight roller 43 suppresses the relative movement of the drive side movable pulley piece 40, cam plate 41 and second weight roller 43 in the axial direction, so that the second weight roller 43 can be prevented from collision with the second pulley side guide surface 40c and the cam plate 41.

[0035] Here "movement of the second weight roller in the radial direction is actually prevented by the second stopper surface 42h" describes the state of prevention where movement of the second weight roller 43 in the axial direction after coming into contact with the second stopper surface 40h is prevented, but there is a possibility of slight movement in the radial direction to such as extent as not to govern movement of the drive side movable pulley piece 40 in the axial direction.

[0036] As shown in Fig. 2, the driven pulley 48 of the automatic transmission 35 is attached at the left end of the driven shaft 47 arranged at a rear position of the case body 7a of the transmission case 7 and oriented in a widthwise direction of a motorcycle 1. As shown in Fig. 8, the driven pulley 48 comprises a driven side fixed pulley piece 52 fixed integrally to an inner sleeve 51 rotatably supported on the driven shaft 47 by a pair of bearings 40 and 50, a driven side movable pulley piece 54 fixed integrally to an outer sleeve 53 slidably fitted in the axial direction and rotating direction of driven shaft 47 to an outer periphery of the inner sleeve 51, and a spring 55 formed from of a cylindrical pressed coil spring, urging the driven side movable pulley piece 54 against the driven side fixed pulley piece 52 by its spring force.

[0037] A cam groove 57 that enables relative movement of the driven side movable pulley piece 54 in the axial direction with respect to the driven side fixed pulley piece 52 is provided on an outer sleeve 53. The cam groove 57 consists of a sloped section that enables the driven side fixed pulley piece 52 and the driven side movable pulley piece 54 to move in a rotating direction and axial direction in the condition that the difference of the rotational speed between the driven side fixed pulley piece 52 and the driven side movable pulley piece 54 is larger than a prescribed value. Grease is filled in the cam groove 58 where the driven side fixed pulley piece 52 and the driven side movable pulley piece 54 can rotate integrally under normal conditions. An oil seal 58 is mounted on the two ends of the inner periphery of outer sleeve 53 that contact and slide on the outer periphery of the inner sleeve 51. A cam groove 57 is also covered in an oil tight manner by a seal cover 60 having a cylindrical shape fitted into an outer periphery of outer sleeve 53 via an O ring 59. A spring bearing section 60a that the right end of the spring 55 comes into contact with is arranged at the right end of the seal cover 60, and the spring bearing section 60a comes into contact with the driven side movable pulley piece 54.

[0038] With respect to the driven shaft 47, a centrifugal starting clutch 36 provided at the left end positioned further to the left than the driven side movable pulley piece 54 comprises a clutch outer 61 spline connected to the driven shaft 47, fixed in an axial direction, and rotating integrally with the driven shaft 47, and a drive plate 62 fixed to and rotating integrally with the inner sleeve 51 at an inner side of the clutch outer 61. In a condition where the inner sleeve 51 rotates faster than a prescribed first rotational speed n1 mentioned later, a clutch shoe 63 swingably supported by a drive plate 62 swings and moves to an outer side in the radial direction by centrifugal force against the spring force of the clutch spring 64. Then frictional member 65 provided on an outer periphery of the clutch shoe 63 comes into contact with the inner peripheral surface of the clutch outer 61, and the starter clutch 36 becomes connected.

[0039] A spring 55 is guided by a spring guide 66 made of self-lubricating synthetic resin such as nylon and arranged at an inner side so as to keep its cylindrical shape during expansion and compression, and therefore the linearity of the spring force is secured. A spring guide 66 comprises a flange section 66a composing a spring junction that the left end of the spring 55 comes into contact with, and a cylindrical section 66b arranged inside the spring 55 and extending in an axial direction of the spring 55. The spring guide 66 is supported by the flange section 66a fitted into an inner periphery of an indented section provided on the drive plate 62, and an inner periphery of the cylindrical section 66b fitted into the seal cover 60.

[0040] As shown in Fig. 9, a cylindrical section 66b of the spring guide 66 with the similar inside diameter along its axial line comprises a similar diameter member 66c with a similar outside diameter, first tapered section 66d having a tapered shape with a diameter decreasing at the end, and a second tapered section 66e with a diameter decreasing at the end and sloping more than the first tapered section 66d, in the order starting from the flange section 66a to the end along the axial line.

[0041] Lengths of the similar diameter section 66c, first tapered section 66d, and second tapered section 66e in the axial direction are set at a suitable length. The length of the similar diameter section 66c, which comes into contact with an inner periphery of the spring 55, is the thickest and has high rigidity, is set at a length capable of supporting the spring 55 in a stable condition while suppressing deflection of the spring 55 in a radial direction caused by vibrations. At the first tapered section 66d a slight space is formed between the inner periphery of the spring 55 to protect against frictional force caused by coming into contact with the spring 55 and enable smooth expansion prevent the spring 55 from collapsing or bending by making the slope of the taper gentle. The second tapered section 66e with a steep slope adjacent to the end forms a relatively large space between inner periphery of the spring 55, so that a spiral wire rod forming the spring 55 does not get caught on the end of spring guide 66 when the spring 55 is compressed. A seal cover 60 fitted into an inner periphery of the spring guide 66 is positioned on an inner periphery of the first tapered section 66d and the second tapered section 66e in the state where the driven side movable pulley piece 54 is in the very vicinity of the driven side fixed pulley piece 52.

[0042] With the drive pulley 38 and driven pulley 48 formed as described as above, each fixed pulley piece 39, 52 and movable pulley piece 40, 54 sandwich the V-belt 67 wound around both pulleys 38, 48 between the contact surface of the V-belt 67 arranged at their opposite sides in a cone shape.

[0043] Referring to Fig. 2 and Fig. 3, the driven shaft 47 is linked to a rear shaft 12 by the series of gears forming the final reduction gear 37 and drives the rear shaft 12. A large gear 69 with a large diameter and small gear 70 with a small diameter are provided on the middle shaft 68, the gear 71 with a small diameter on the driven shaft 47 meshes with large gear 69 on the middle shaft 68, and the small gear 70 on the middle shaft 68 meshes with a large gear 72 on the rear shaft 12. The rotation of the driven shaft 47 is reduced in 2 steps and transmitted to the rear shaft 12 by the final reduction gear 37 formed as described above.

[0044] Next, a transmitting operation of this automatic transmission 35 will be described referring to Figs. 5, 8, and 10. When the internal combustion engine 4 is operated and the rotational speed of the crankshaft 19 is not greater than a first rotational speed N1, the starting clutch 36 is disengaged, and so the driven shaft 48 is stopped and motorcycle 1 is in a stationary state. Here at the driven pulley 38, the drive side movable pulley piece 40 is at the furthest point in a radial direction of crankshaft 19 from the drive side fixed pulley piece 40 due to the tension of the V-belt 67, and here the wrapping radius of V-belt 67 gets smallest, while at the driven pulley 48 the driven side movable pulley piece 54 is urged towards the driven side fixed pulley piece 52 and becomes closest to it and so the wrapping radius of V-belt 67 gets the largest, and the rotational power of crankshaft 19 is transmitted to driven pulley 48 at the largest gear ratio.

[0045] When rotational speed is greater than the first rotational speed N1, the clutch shoe 63 is reciprocated by centrifugal force and comes into contact with the clutch outer 61. Then the starting clutch 36 starts to get connected, the driven shaft 47 starts to rotate, and the motorcycle starts cruising. The starting clutch 36 is put into a completely connected state, and the rotational power of the crankshaft 19 is transmitted to the driven pulley 47 at the largest gear ratio. With the increase in rotational speed, centrifugal force of the first weight roller 42 and second weight roller 43 of the drive pulley 38 becomes increased. However, while the centrifugal force is not greater than a second rotational speed N2, the component of force to move the drive side movable pulley piece 40 39 in axial direction towards the drive side fixed pulley piece is not greater than the tension of the V-belt 67 that moves the drive side movable pulley piece 40 out from the drive side fixed pulley piece 39. Therefore the first weight roller 42 and the second weight roller 43 stay at the default position between the corresponding first and second pulley side guide surfaces 40b, 40c and the cam side guide surface 41a (position Q1, R1 shown in Fig. 5). There the wrapping radius of the V-belt 67 at the drive pulley 38 becomes minimum (position P1 shown in Fig. 5), and the wrapping radius of the V-belt 67 at the driven pulley 48 becomes maximum (position P1 shown in Fig. 8), and the gear ratio is kept at the maximum. The maximum gear ratio is kept in the low-speed rotating range where the rotational speed increases up to the second rotational speed N2, and at this gear ratio, the rotational power of crankshaft 19 is transmitted to the driven shaft 47, and the speed of the vehicle changes in proportion to the rotational speed.

[0046] When rotational speed becomes greater than the second rotational speed N2, the component of force of centrifugal force of the first and second weight roller 42 and 43 that moves the drive side movable pulley piece 40 towards the drive side fixed pulley piece 39 in an axial direction becomes larger than the tension of V-belt 67. There, at the drive pulley 38, first and second weight rollers 42 and 43 are guided by corresponding first and second pulley side guide surfaces 40b and 40c and the cam side guide surface 41a, and rotate and move in a radial direction. The drive side movable pulley piece 40 moves in an axial direction and approaches the

drive side fixed pulley piece 39, and the wrapping radius of V-belt 67 becomes larger. At the driven pulley 48, against the spring force of the spring 55, the driven side movable pulley piece 54 moves in an axial direction and moves apart from the driven side fixed pulley piece 52 while compressing the spring 55. The wrapping radius of the V-belt 67 becomes smaller and the speed is automatically changed.

[0047] When the rotational speed reaches the minimum prescribed rotational speed where the middle gear ratio will be set, the second weight roller 43 comes into contact with the second stopper surface 40h and its movement in the radial direction is actually prevented (position R2 shown in Fig. 5), the component of force of the centrifugal force of first weight roller 42 that moves the drive side movable pulley piece 40 in an axial direction is not greater than the tension of the V-belt 67 which moves the drive side movable pulley piece 40 out from the drive side fixed pulley piece 39. Therefore the drive side movable pulley piece 40 and first weight roller 42 stay in the current position (position Q2 shown in Fig. 5). Here the wrapping radius of the V-belt 67 around the drive pulley 38 becomes larger (position P2 shown in Fig. 5), the wrapping radius of V-belt 67 around the driven pulley 48 becomes smaller (position P2 shown in Fig. 8), and the middle gear ratio which is smaller than the maximum gear ratio is set. Also, in the middle-speed rotation range where rotational speed increases up to 3rd rotational speed N3, the middle gear ratio is maintained, and under this middle gear ratio, the rotational power of crankshaft 19 is transmitted to the driven shaft 47, and the speed of the vehicle changes corresponding to the rotational speed.

[0048] When the rotational speed increases and exceeds the 3rd rotational speed N3, a component of force of the centrifugal force of the first weight roller 42, that moves drive side movable pulley piece 40 towards the drive side fixed pulley piece 39, becomes larger than the tension of the V-belt 67. At drive pulley 38, first weight roller 42 is guided by corresponding first pulley side guide surface 40b and cam side guide surface 41 and rolls and moves in the radial direction, and so the drive side movable pulley piece 40 moves in an axial direction and approaches the drive side fixed pulley piece 39, and the wrapping radius of V-belt 67 becomes larger. At the driven pulley 48, the driven side movable pulley piece 54 moves in an axial direction against the spring force of the spring 55 while compressing the spring 55, and as the wrapping radius of V-belt 67 becomes smaller, transmission can be automatically operated.

[0049] At this time, the second weight roller 43 is not involved in the movement of the drive side movable pulley piece 40 in the axial direction and rolls slightly over the sloped second stopper surface 40h in radial direction, and is pressed onto the cam plate 41 by the force effected by a moment M based on the centrifugal force and a component of force Ft of the centrifugal force in the direction toward the cam plate.

[0050] When first weight roller 42 comes into contact with the first stopper surface 40g and is prevented from moving in the radial direction (position Q3 shown in Fig. 5), the drive side movable pulley piece 40 stays at the position and the wrapping radius of the V-belt around the drive pulley 38 becomes maximum (position P3 shown in Fig. 5) and the wrapping radius of the V-belt 67 around the driven pulley 48 becomes minimum (position P3 shown in Fig. 8), and a minimum gear smaller than the middle gear ratio is set. The second weight roller 43 is pressed onto the cam plate 41 after moving slightly in a radial direction (position P3 shown in Fig. 5). In the following high-speed rotation range, the minimum gear ratio is maintained, and with this gear ratio, the rotational force of crankshaft 19 is transmitted to the driven shaft 47, and the vehicle speed changes corresponding to the rotational speed.

[0051] The following is a description of the operational effects of the embodiment with the configuration described above.

[0052] In the high rotation range of the internal combustion engine in the state where the second weight roller 43 comes into contact with second stopper and is actually prevented from moving in the radial direction, when a space is formed between the second weight roller 43 and the second pulley side guide surface, vibrations of the internal combustion engine, etc., for example, a vibration of the crankshaft 19 in an axial direction caused by the combustion and burst energy around the top dead center of the piston 20 of the internal combustion engine 4, is transmitted to the drive pulley 38 and cause relative movement between the drive side movable pulley piece 40, the cam plate 41 and the second weight roller 43 in an axial direction of the crankshaft 19 and second weight roller 43 may collide with second pulley side guide surface 40c of the drive side movable pulley piece 40 and cam side guide surface 41a. As the weight of the second weight roller 43 is lighter than the weight of the first weight roller 42, the energy of collision is small. Therefore wear of second pulley side guide surface 40c, cam side guide surface 41a, and second weight roller 43 can be reduced. Further, as the energy of collision is small, a crashing noise due to collision is small and so noise can be reduced.

[0053] As a result, wear of the second pulley side guide surface 40c, cam side guide surface 41a and second weight roller 43 will be reduced. The second weight roller 43 can move in a radial direction smoothly, therefore transmission can be performed smoothly. As wear is reduced, set transmission characteristics can be kept over the long term and noise due to the collision of second weight roller 43 can be reduced.

[0054] Furthermore, in the high-speed rotation range, as the weight of the second weight roller 43 is lighter than the first weight roller 42, occurrence of wear and noise due to the collision of the second weight roller 43 against the second pulley side guide surface 40c and the cam side guide surface 41a are reduced. Addition-

ally, when vibrations of the internal combustion engine 4, etc. are transmitted to the drive pulley 38 and a force causing the relative movement between the drive side movable pulley piece 40, the cam plate 41 and the centrifugal weight in an axial direction of the crankshaft 19 acts, relative movement of the second weight roller 43 in an axial direction of the crankshaft 19 can be suppressed because the second weight 43 roller is pressed onto the cam plate 41 by a pressing force generated as a result of coming into contact with the sloped second stopper surface 40h, i.e., a force effected by moment M due to centrifugal force generated at the second weight roller and a component of force Ft in a direction towards cam plate 41. Therefore collisions of the second weight roller 43 against the second pulley side guide surface 40c and cam side guide surface 41a can be reduced, and the occurrence of wear of second pulley side guide surface 40c, cam side guide surface 41a and second weight roller 43 due to collision can be suppressed. Occurrence of noise due to collision can also be suppressed.

[0055] As a result, as the occurrence of collisions of second weight roller 43 can be suppressed, wear of the second pulley side guide surface 40c, cam side guide surface 41a and second weight roller 43 can be further reduced, and therefore the second weight roller 43 can move in a radial direction smoothly enabling smooth transmission. Also, as wear of those parts is reduced, set transmission characteristics can be maintained over the long term. Furthermore, noise due to the collisions of the second weight roller 43 can be further reduced.

[0056] A space, which becomes wider at the end, is formed between the outer periphery of the second tapered section 66e of the tapered section 66b of the cylindrical spring guide arranged inside the spring 55 consisting of a cylindrical coil spring of the driven pulley 48 and the inner periphery of spring guide 55 . Therefore when changing speed, the driven side movable pulley piece 54 moves in an axial direction as the driven side movable pulley piece 54 is moved in the axial direction by the centrifugal force acting on the first and second weight rollers 42 and 43 and the spring 55 is compressed, and the wire rod wound in a spiral will not be caught by coming into contact with the end of the spring guide.

[0057] As a result, the driven side movable pulley piece 54 can move in an axial direction smoothly, enabling smooth transmission. As only the end of the spring guide has a tapered shape, the spring can be prevented from collapsing or bending due to parts of the spring guide 66 other than its end, and therefore the function of the spring guide will not be lost. In particular, at the first tapered section 66 with a more gentle slope compared the tapered section 66e, a slight space is formed between the first tapered section and the inner periphery of the spring 55 so that the spring 55 will not be prevented from smooth expansion and compression by frictional force generated by coming into contact with the spring 55, and prevented from collapsing and bending by making the taper slope gentle.

[0058] Additionally, in the state where the driven side movable pulley piece 54 is in the very vicinity of the driven side fixed pulley piece 52, the seal cover 60 meshed with the inner periphery of the spring guide 66 is positioned in the inner periphery of the first tapered section 66d and second tapered section 66e. Despite the fact that the spring guide 66 is thinned by the taper, as its rigidity is strengthened by the rigidity of seal cover 60, both the tapered sections 66d and 66e merely get displaced by vibrations, and therefore the spring guide 66 can function efficiently.

[0059] The spring guide 66 is made of self-lubricating synthetic resin. Frictional force against the spring 55 is kept small by the self-lubrication of the spring guide 66 in the case where the spring 55 comes into contact with and slides on spring guide 66. Therefore the spring 55 can be expanded and compressed smoothly, enabling smooth transmission.

[0060] Following is a description of the embodiment with a modified configuration of part of the configuration of the embodiment mentioned above.

[0061] In the preceding embodiment, the weight of second weight roller 43 is lighter than the first weight roller 42, and the second stopper surface 40h is sloped so that a pressing force to press second weight roller 46 onto cam plate 41 will be generated by contact of the second weight roller 43 against the second stopper surface 40h. Weight of the second weight roller 43 may also be made lighter than the first weight roller 42, and the second stopper surface 40h may be provided as a plane surface that goes radially outwards against the orthogonal plane surface as well as the first stopper surface 40g. The weight of the second weight roller 43 may also be equal to that of the first weight roller 42, and the second stopper surface 40h may be sloped so that pressing force to press the second weight roller 46 onto the cam plate 41 will be generated by the contact of the second weight roller 43 against the second stopper surface 40. In any case, as wear of second pulley side guide surface 40c, cam side guide surface 41a and second weight roller 43 due to collisions of the second weight roller 43 are suppressed, the second weight roller 43 can move in a radial direction smoothly, thus enabling smooth transmission. also, due to the suppression of the wear of these elements, set transmission characteristics can be maintained over the long term, and furthermore, noise due to the collision of the second weight roller 43 can be suppressed.

[0062] In the embodiment described above, a plurality of guide surfaces arranged with clearance in the peripheral direction to guide the movement of the first and second weight rollers 42 and 43 in the radial direction are provided as first and second pulley side guide surfaces 40b, and 40c on the drive side movable pulley piece 40. However, a guide surface corresponding to these first and second pulley side guide surface 40b and 40c can

be provided on the cam plate 41, the guide surface consisting of a circular surface that can be provided on a rear surface of the drive side movable pulley piece 40. In this case, the first and second stopper surfaces 40g and 40h can be provided on the cam plate 41 as well. The second stopper surface 40h arranged as a plane surface can be arranged as a circular surface with a similar slope.

[0063] In the embodiment described above, there are 2 types for each of the guide surfaces 40b and 40c having different shapes, and weight rollers 42 and 43 with different weights. Those guide surfaces and weight rollers can be provided with 3 types for each, and in this case, more than 2 middle gear ratios can be set. Additionally, numbers of the plurality of guide surfaces arranged with clearance in a peripheral direction are not limited to 6 and can set at appropriate numbers. For example, when there are 3 types of guide surface, 9 guide surfaces can be provided. Also, it is possible to have a drive source other than an internal combustion engine 4 as the engine.

[0064] The invention provides a V-belt-type automatic transmission for a vehicle capable of smooth transmission.

To achieve this, a V-belt-type automatic transmission for a vehicle is provided with a drive pulley 38 and a driven pulley 48, wherein a plurality of centrifugal weights 42 and 43 arranged between a movable pulley piece 40 of a drive pulley 38 and a cam plate 41 are moved in a radial direction by the centrifugal force, the wrapping radius of the V-belt 67 wound around the drive pulley 38 and the driven pulley 48 is changed, a maximum gear ratio in a low-speed rotation range and a minimum gear ratio in a high-speed rotation range are set, the movement in a radial direction of the centrifugal weight 43, one of the plurality of centrifugal weights 42 and 43, is actually prevented by the stopper surface 40h at the rotational speed in a middle-speed rotation range, and the middle gear ratio is set. The centrifugal weight 43 is made lighter than the remaining centrifugal weight 42, and the stopper surface 40h is sloped, and therefore a pressing force pressing the centrifugal weight 43 against cam plate 41 will be generated.

Claims

1. A V-belt-type automatic transmission for a vehicle, having a wrapping radius of a V-belt (67), which is wound around a drive pulley (38) provided on a drive shaft of an engine and a driven pulley (48) provided on the driven shaft to transmit torque of the drive shaft to the driven shaft, changed based on movement in a radial direction along both guide surfaces of a plurality of centrifugal weights (42,43) arranged between a pulley side guide surface (40b,c) provided on a movable pulley piece (40) of the drive pulley (38) and a cam side guide surface (41a) provided on a cam plate (41), a maximum gear ratio in a low-speed rotation range and a minimum gear ratio in a high-speed rotation range are set, and some (43) of the plurality of centrifugal weights are actually prevented from moving in a radial direction at a speed faster than a prescribed rotational speed in a middle-speed rotation range, to thereby set a middle gear ratio in a middle-speed rotation range, wherein

   some (43) of the centrifugal weights are lighter than the remaining (42) centrifugal weights.

2. A V-belt-type automatic transmission for a vehicle, having a wrapping radius of a V-belt (67), which is wound around a drive pulley (38) provided on a drive shaft of an engine and a driven pulley (48) provided on the driven shaft to transmit torque of the drive shaft to the driven shaft, changed based on movement in a radial direction along both guide surfaces of a plurality of centrifugal weights (42,43) arranged between a pulley side guide surface (40b,c) provided on a movable pulley piece (40) of the drive pulley (38) and a cam side guide surface (41a) provided on a cam plate (41), a maximum gear ratio in a low-speed rotation range and a minimum gear ratio in a high-speed rotation range are set, and some (43) of the plurality of centrifugal weights are actually prevented from moving in a radial direction at a speed faster than a prescribed rotational speed in a middle-speed rotation range, to thereby set a middle gear ratio in a middle-speed rotation range, wherein

   a stopper surface (40h) provided on the movable pulley piece, which actually prevents some of the centrifugal weights from moving in a radial direction, or a stopper surface provided on the cam plate, are sloped so that a pressing force for pushing some of the plurality of centrifugal weight against the cam plate is generated based on contact of some of the plurality of centrifugal weights against the stopper surface.

3. The V-belt-type automatic transmission for a vehicle , provided with a drive pulley (38) attached to a drive shaft of the engine, a driven pulley (48) attached to a driven shaft, and a V-belt (67) wound around the drive pulley and the driven pulley to transmit the rotational power of the drive pulley to the driven pulley, the wrapping radius of the V-belt around the drive pulley and the driven pulley being changed by moving a movable pulley piece (40) of the drive pulley (38) against force of a spring (55) in response to the movable pulley piece of the drive pulley being moved by centrifugal force of the centrifugal weights, wherein

   the spring (55) is a cylindrical coil spring, and an outer peripheral surface of a tip (66d,e) of a cylindrical spring guide (66) arranged inside the spring

has a tapered shape, with the outer diameter becoming smaller towards the end.

4. The V-belt-type automatic transmission for a vehicle of claim 3, wherein the spring guide (66) is made of synthetic resin with self lubricating characteristics.

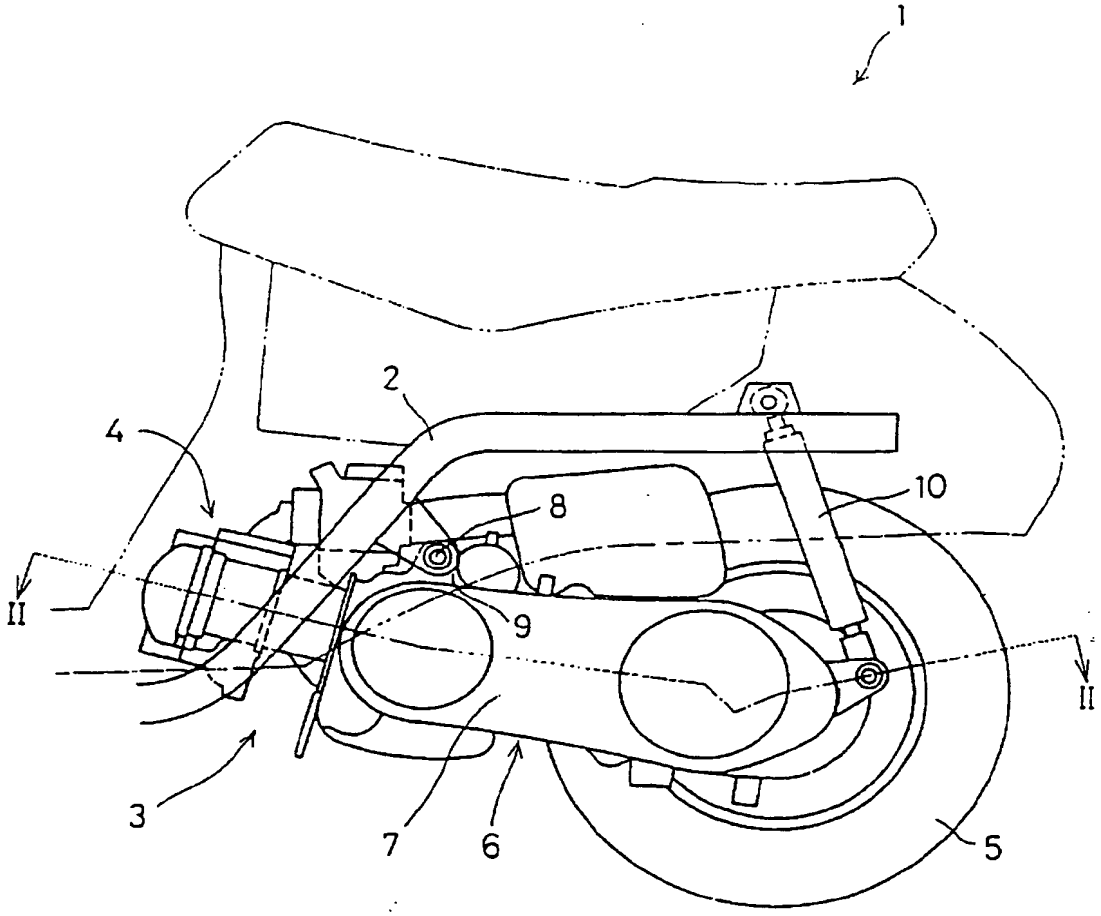

FIG. 1

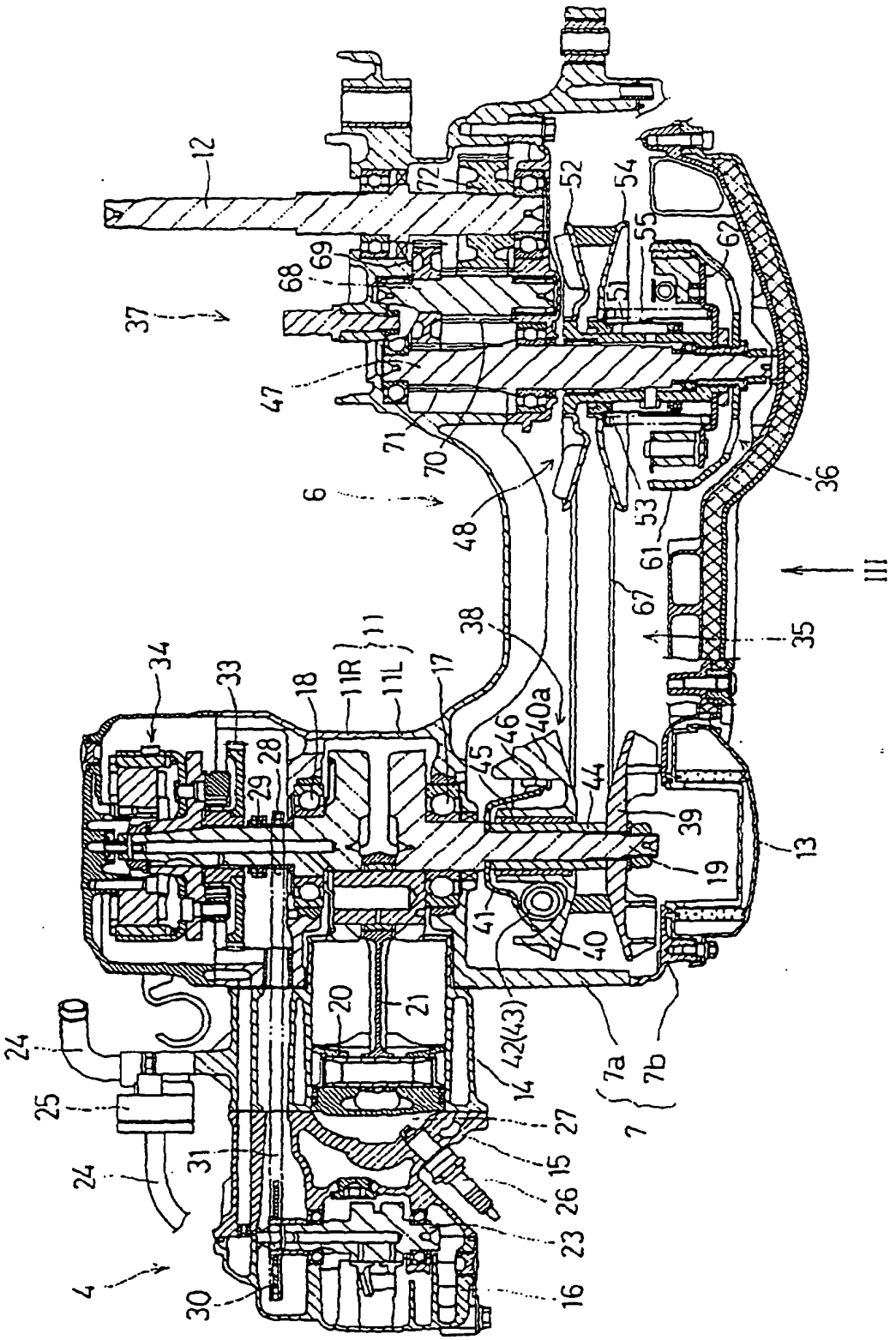

FIG. 2

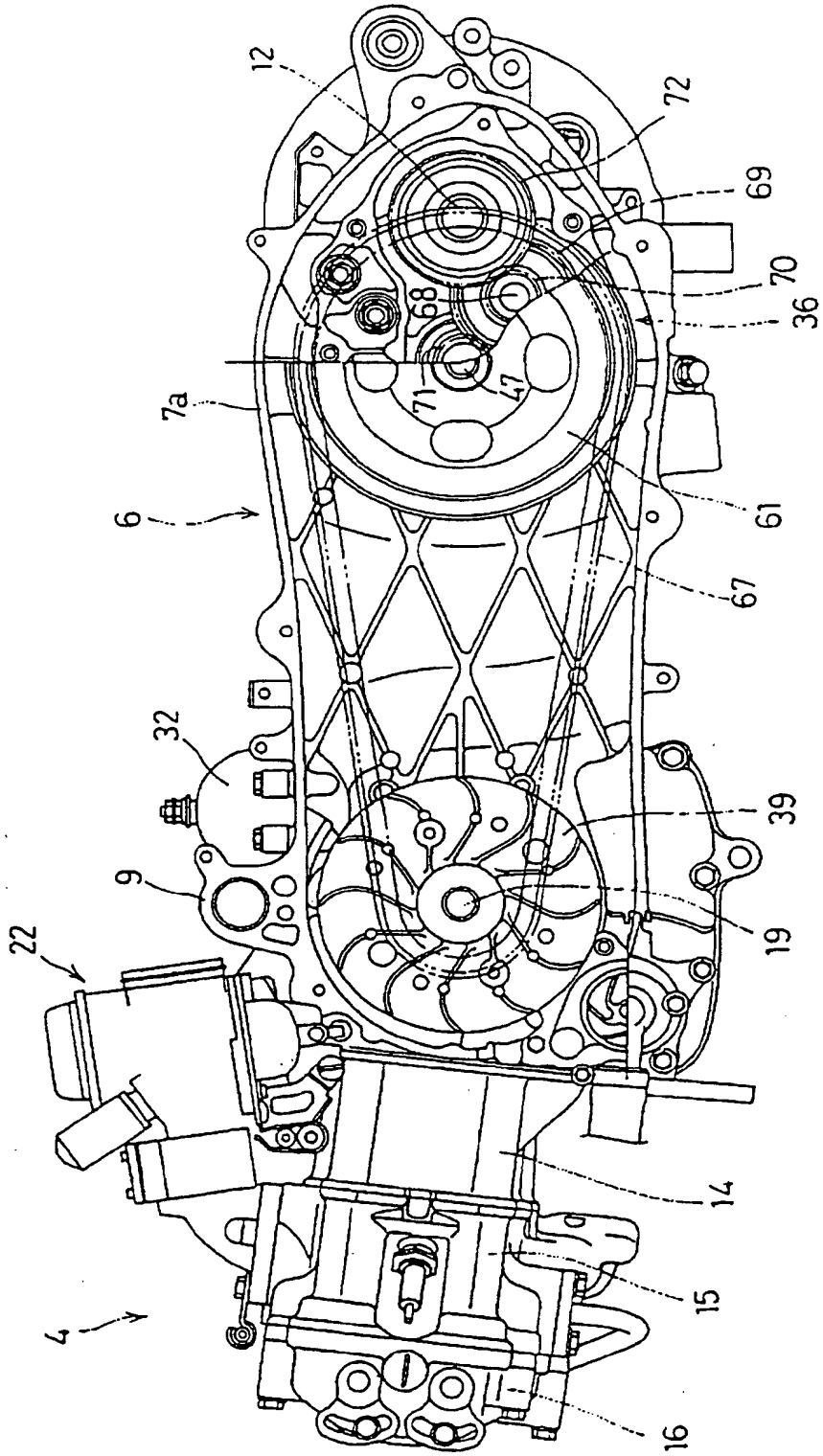

FIG. 3

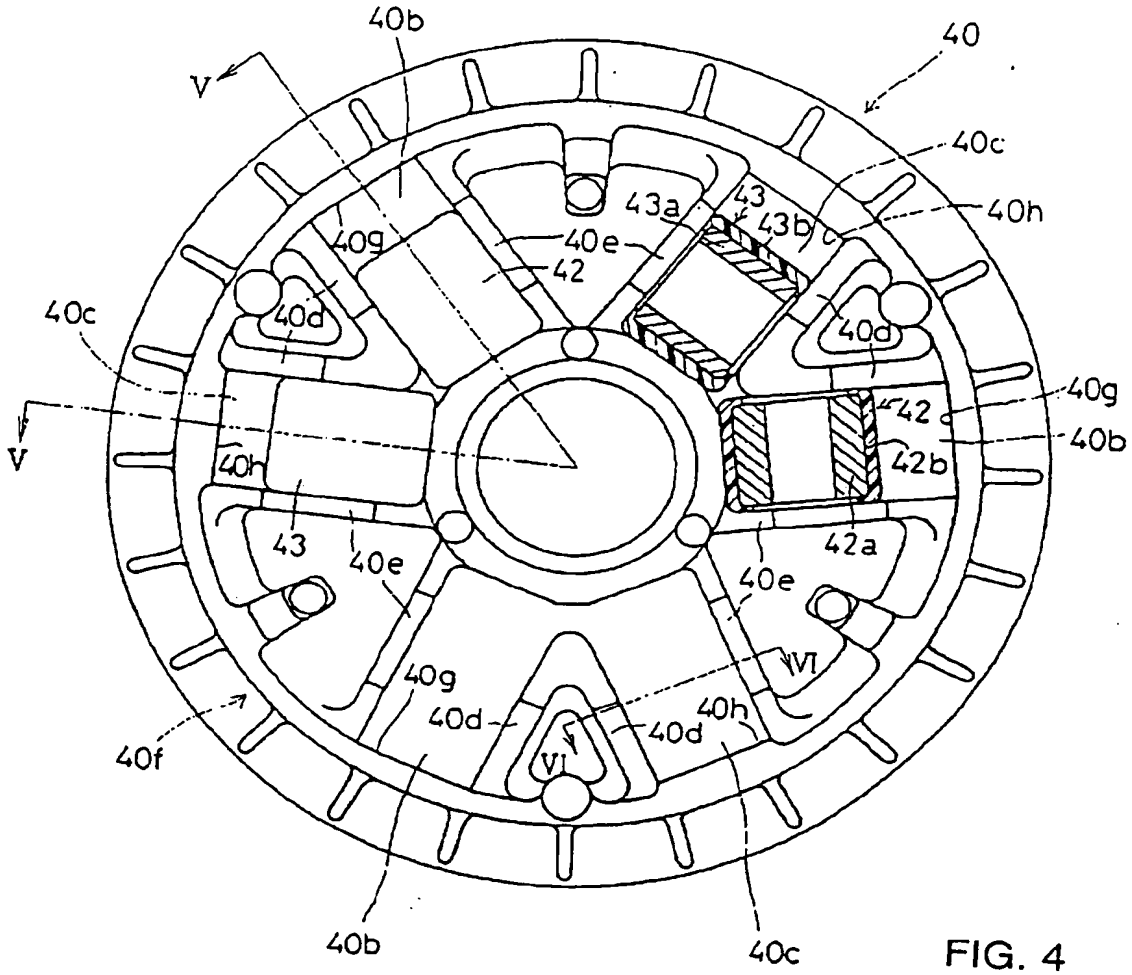

FIG. 4

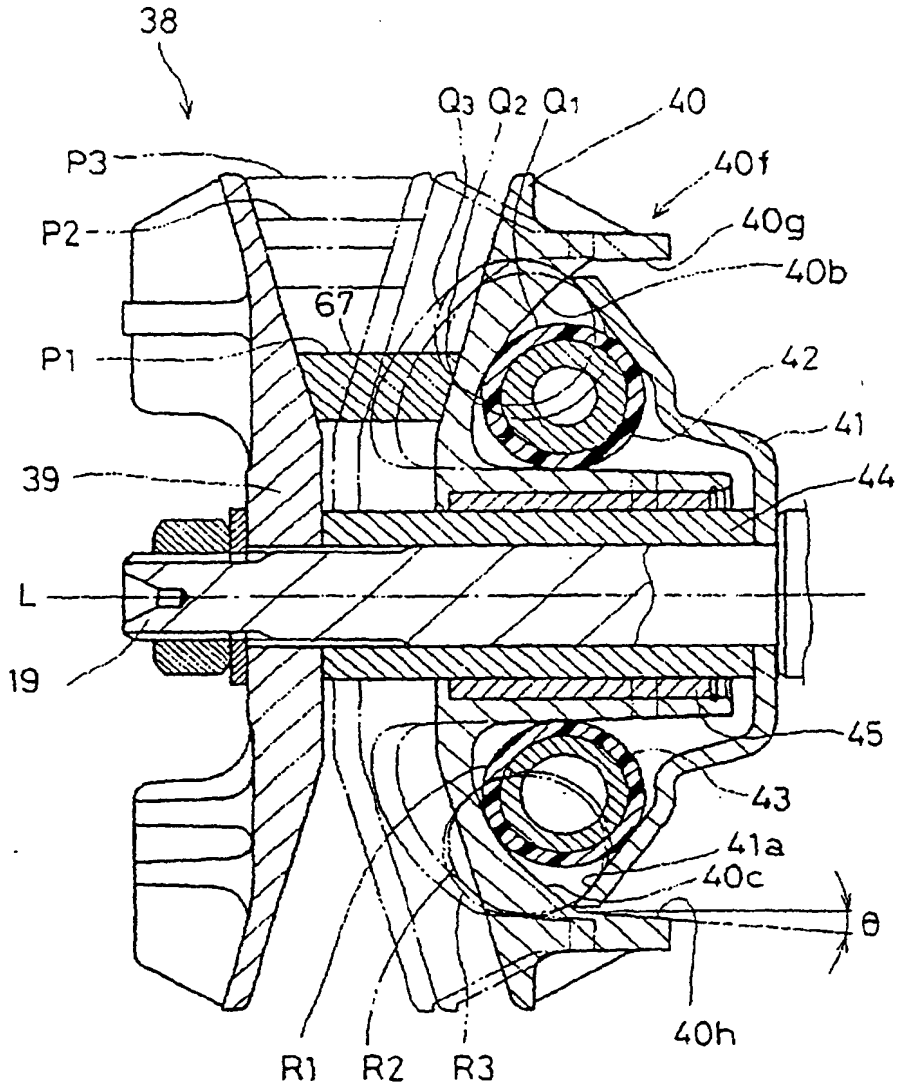

FIG. 5

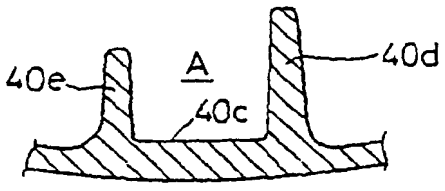

FIG. 6

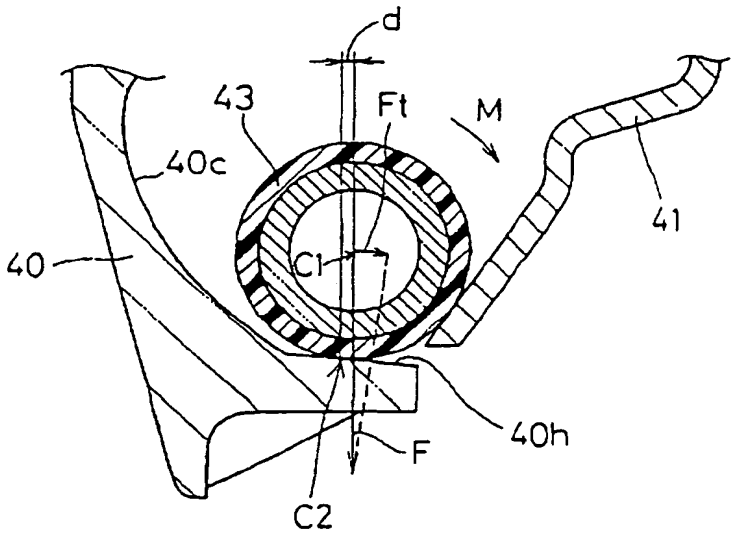

FIG. 7

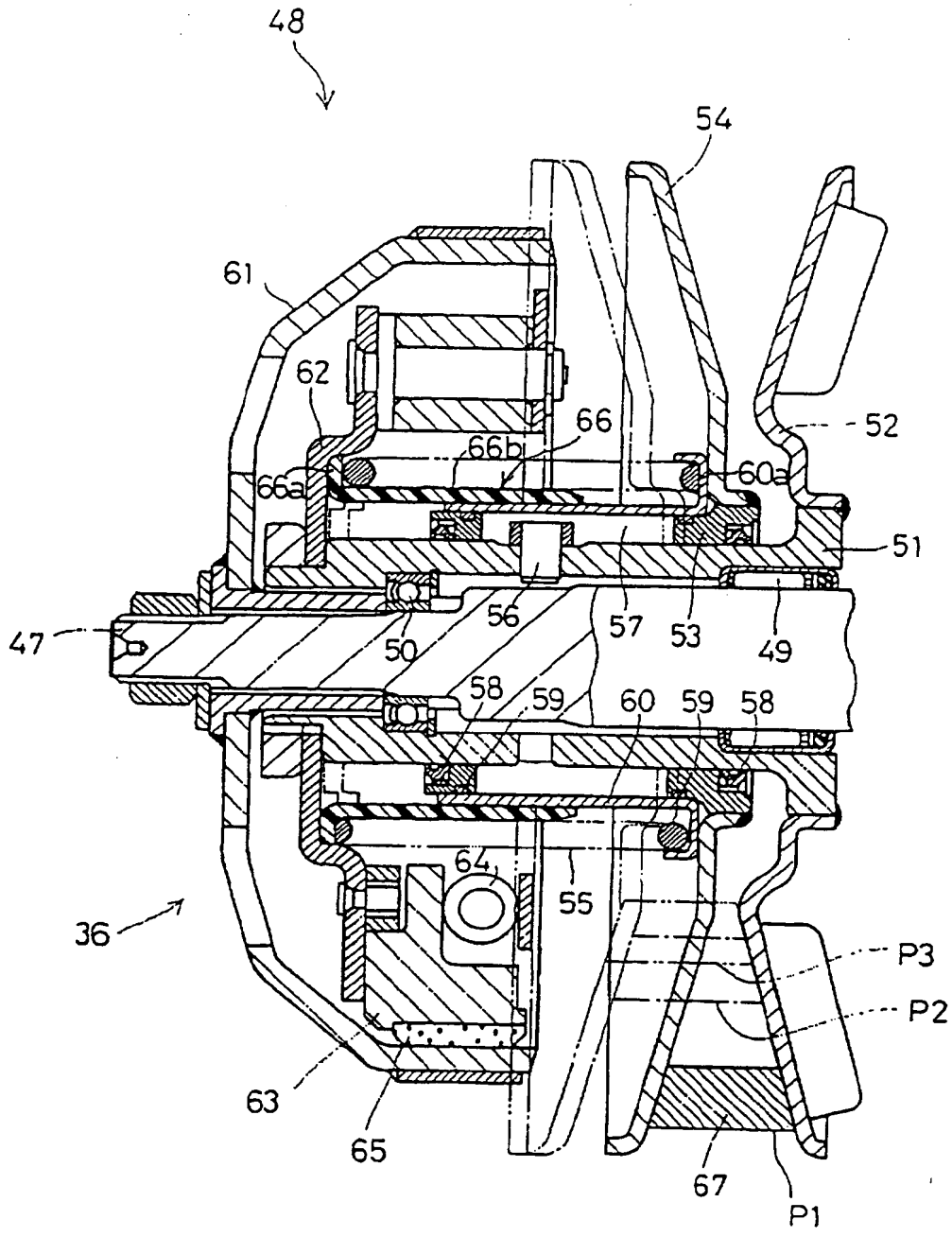

FIG. 8

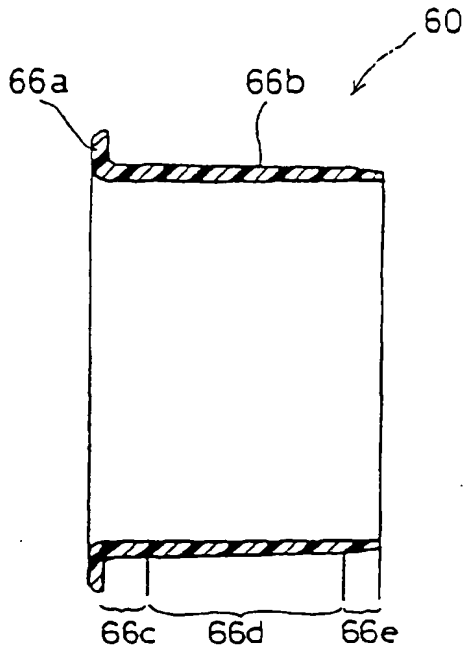

FIG. 9

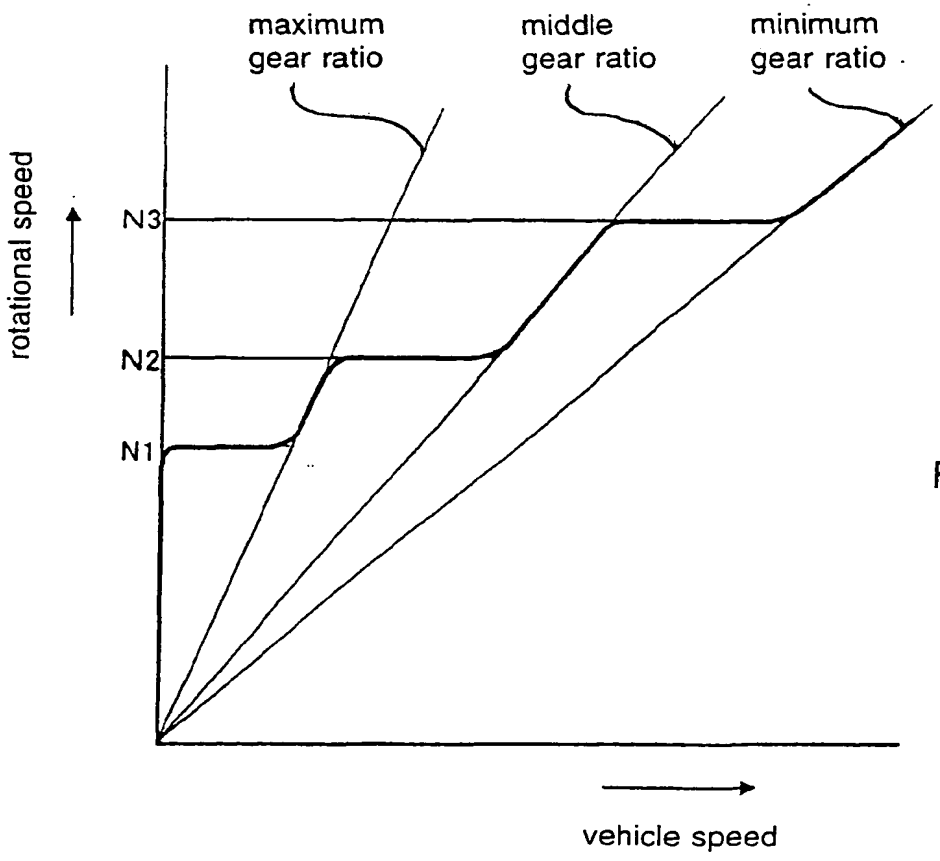

FIG. 10

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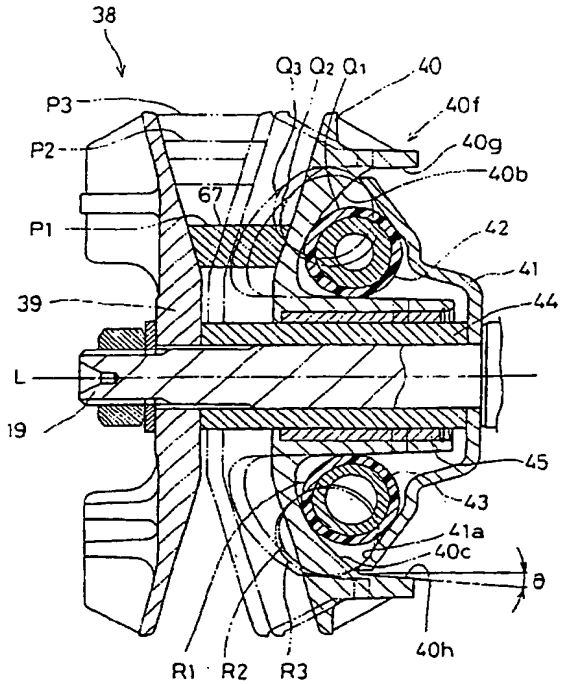
(54) V-belt-type automatic transmission for vehicle

(57) To achieve this, a V-belt-type automatic transmission for a vehicle is provided with a drive pulley 38 and a driven pulley 48, wherein a plurality of centrifugal weights 42 and 43 arranged between a movable pulley piece 40 of a drive pulley 38 and a cam plate 41 are moved in a radial direction by the centrifugal force, the wrapping radius of the V-belt 67 wound around the drive pulley 38 and the driven pulley 48 is changed, a maximum gear ratio in a low-speed rotation range and a minimum gear ratio in a high-speed rotation range are set, the movement in a radial direction of the centrifugal weight 43, one of the plurality of centrifugal weights 42 and 43, is actually prevented by the stopper surface 40h at the rotational speed in a middle-speed rotation range, and the middle gear ratio is set. The centrifugal weight 43 is made lighter than the remaining centrifugal weight 42, and the stopper surface 40h is sloped, and therefore a pressing force pressing the centrifugal weight 43 against cam plate 41 will be generated.



EP 1 132 656 A3

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EUROPEAN SEARCH REPORT

Application Number
EP 01 10 4363

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	WO 97 04250 A (BERTO JOSEPH J) 6 February 1997 (1997-02-06) * page 10, line 5 - line 23 * * page 17, line 26 - page 19, line 3 * * figures 5-8 *	1,2	F16H61/00F16H55/5
A		3,4	
A	PATENT ABSTRACTS OF JAPAN vol. 008, no. 160 (M-312), 25 July 1984 (1984-07-25) & JP 59 054849 A (HONDA GIKEN KOGYO KK), 29 March 1984 (1984-03-29) * abstract *	1	
A	EP 0 404 472 A (FUKUNAGA HISAO ;OKAWA HIROKAZU (JP)) 27 December 1990 (1990-12-27) * the whole document *	1	
X	DE 20 45 732 A (SIEMENS AG) 23 March 1972 (1972-03-23) * page 5, paragraph 2 - page 6, paragraph 1 * * figures 5-8 *	2	TECHNICAL FIELDS SEARCHED (Int.Cl.7) F16H
A		1,3,4	
X	US 5 421 784 A (ROBERT JEAN) 6 June 1995 (1995-06-06) * figure 1 *	3	
A		1,2,4	
X	US 3 362 242 A (WATKINS LUCIUS D) 9 January 1968 (1968-01-09) * figure 1 *	3	
A	US 3 280 648 A (NELSON BERTEL S) 25 October 1966 (1966-10-25) * figures 1,2 *	1-4	

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	12 December 2003	Hassiotis, V

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
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D : document cited in the application
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EPO FORM 1503 03.82 (P04C01)

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EUROPEAN SEARCH REPORT

Application Number
EP 01 10 4363

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	EP 0 730 108 A (HONDA MOTOR CO LTD) 4 September 1996 (1996-09-04) * figure 1 *	1-4	

TECHNICAL FIELDS SEARCHED (Int.Cl.7)

The present search report has been drawn up for all claims

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Application Number
EP 01 10 4363

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing more than ten claims.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☒ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☐ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

European Patent Office

LACK OF UNITY OF INVENTION
SHEET B

Application Number
EP 01 10 4363

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. Claim : 1

   The subject-matter of claim 1 relates to a V-belt-type automatic transmission in which some of the weights are lighter than others.

2. Claim : 2

   The subject-matter of claim 2 relates to a V-belt-type automatic transmission in which a stopper prevents some of the weights from moving in a radial direction.

3. Claims: 3-4

   The subject-matter of claim 3 relates to a V-belt-type automatic transmission in which a space which becomes wider at its end is formed an periphery of a spring and an outer periphery of the end of the spring guide.

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 01 10 4363

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

12-12-2003

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